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Role of Artificial Intelligence in Easy Learning and Teaching of Mathematics

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***Abstract*— This research paper is an analyzed paper to examine the role of Artificial Intelligence (AI) in teaching and learning environment. The use of AI in Mathematics learning offers remarkable opportunities to enhance education experience of educators and learners. Different AI softwares including ChatGPT, GeoGebra and Photo math are studied in this paper. The remarkable benefits of integrating artificial intelligence to education are studied along with challenges that learning era faces with overuse of these softwares.**

***Keywords*— Artificial Intelligence, Mathematics, ChatGPT, Photomath, Geogebra**

I. INTRODUCTION

Artificial Intelligence (AI) is a branch of computer science that enables machines and computer systems to enhance human learning, problem-solving, creativity, decision-making and autonomy. This technology has brought tremendous change in various industries of the real world, including transportation (Bharadiya (2023)), banking (Vanaparthi (2025)), healthcare (Penaluo (2021)) and education (Qu et al. (2022)).The use of AI technologies in education industries has made it easy to understand historically difficult subjects like mathematics, a fundamental to the fields of science, business, engineering and beyond (Harry and Sayudin (2023), Zouek (2024), Dhasal and Devkota (2024)). The remarkable development of such technologies successfully enhanced the problem solving skills of students over the last few decades while supporting the instructors and educators in creating dynamic, personalized and engaged learning environment. The use of AI in mathematical learning is examined in this paper, focusing on its ability to solve issues in instructional practices and improve outcomes of the students.

Mathematics plays a crucial role in both education and day to day life. It does not only enhance the problem solving abilities of individuals but also makes them critical thinkers, promotes their creativity and supports personal growth, enabling their existence in data driven world. Many researchers and practitioners pointed out the role of mathematics for understanding different professional and academic fields(Li etal.(2024), Sayudin (2023), Pedro (2020)).

Despite of the fact that mathematics plays a significant role in every field of life, many students fail to cope up with this subject. Darmayanti (2024) has reported several reasons including weak basic knowledge, backward teaching and learning methods, math related anxiety among students, less interest of students in this subject and restricted access to different learning resources that lead to poor performance of learners. Therefore, improving the interest of students in mathematics requires the adaption of effective educational strategies like advanced and effective teaching techniques, supportive classroom environment, encouraging positive attitude towards mathematics, proper subject practices, independent access to various learning resources and integrating mathematical concepts with real world applications (How and Hung (2019)). Grajeda et al. (2024) reported that teachers can boost the mathematical skills of students by creating a positive and supportive learning environment, by including the technology on the learning platform, adjusting instruction based on progress and promoting self-reflection.

By providing innovative methods, tools and resources integrated with traditional teaching methods, technology enriches the mathematical learning (Eabin et al.(2018), Mhlogo et al. (2023), Ahmad (2022)).Apart from this, the technology also provides resources, facilities and computing power required to create and implement artificial intelligence (AI) systems in mathematical classrooms. The use of AI technologies like ChatGPT (Wardat et al. (2023), Supriyadi and Kuncoro (2023), Govender (2023)), Photomath application (Putri et al. (2025)), Cahyanti (2024), Pikri et al. (2023), Zain et al.(2023)), and GeoGebra (Ohajumoke and Spangenberg (2024), Ro maito et al. (2021), Zengin et al. (2012)),in teaching and learning mathematics are gaining popularity among teachers and students. These AI techniques have potential to improve students'engagement and academic outcomes in mathematics by enabling tailored learning experiences, offering immediate feedback and making easy accessibility to difficult learning ideas (Guo et al. (2023), Crust (2023), Egara and Mosimege (2024)).

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However, integrating AI into mathematics education also offers many challenges. These challenges include inaccurate results, overlying of the students on these tools, not cultivating their problem solving skills and many more.

This research paper aims to examine the revolutionary transformation in mathematical education brought by AI technology across all educational levels by utilizing various instructional strategies. Section 1 of this paper provides insight into various AI-based softwares driving for this tremendous transformation in mathematics learning. Section 2 depicts advantages of AI-techniques. Section 3 focuses on challenges and future aspects of AI in education. The importance of all the AI-tools in learning of mathematics and how they have brought change in student's attitude is concluded in section 4.

II. Study Of Different Ai Tools In Mathematics Learning And Education

A. GeoGebra:

GeoGebra, being dynamic software of artificial intelligence, is quite beneficial for both students and teachers in learning mathematics. Markus Hohenwarter introduced GeoGebra as his master's thesis project in 2001. The purpose of GeoGebra was to develop an interactive learning of mathematics. This software helps in understanding different mathematical topics like geometry, statistics, trigonometry, algebra, calculus and arithmetic. With the day by day enhancement of technology, this software has evolved and is now supported by many platforms globally being quite easy in functioning. GeoGebra is cost free and multilingual software, therefore, a learner can use it from anywhere and at any time in an effective way.

GeoGebra is the best platform for learning geometrical concepts as it provides visualization of geometrical problems. It helps the learners to understand how different concepts are applied to get the results to various geometrical problems. The spreadsheet in it enables the users to organize and study data conveniently. This software not just provides knowledge but also helps to test knowledge. 'Exam mode' facility provided in this software helps students to test their abilities.

GeoGebra software is beneficial for all the students from primary level to university level. Studies reported by (Kim et al.(2017) proved that students following the software GeoGebra are much more skilled and have better grasp on topics than the students follow regular ways of teaching. This software helps in enhancing critical thinking power of students.

Despite being extremely handy in many areas, GeoGebra has some limitations as follows:

1. GeoGebra's syntax can be challenging for new users.
2. Many new softwares are nowadays providing more detailed and dedicated models in 3D, than GeoGebra.
3. This software may not be helpful for learning advanced mathematical concepts like differential geometry and algebraic topology.
4. Even though GeoGebra is supported by many platforms, they are not more featured than the desktop version.
5. This software does not provide text-to-speech or speech-to-text help. Therefore, it is not useful for users with disabilities.

B. Photomath

Photomath is a great example of how AI can be used in mathematics education. It is a mobile application that allows users to solve math problems using the camera on their device. Users can scan any math problem related to basic arithmetic, algebra, calculus, or geometry with the Photomath app. The app provides detailed solutions, highlighting each step of the problem, whether typed by the user or scanned in handwritten or printed form. It uses AI-powered algorithms that offer more accurate solutions to mathematical problems, regardless of the user's geographic location or socio-economic status. Many of the app's features have offline functionality, allowing users to access solutions without an internet connection. Additionally, the app provides multiple solutions for the same problem, which promotes a deeper understanding of the concept.

Despite being a powerful tool for solving math problems, the Photomath app has certain limitations as follows:

1. It is limited to basic math problems and cannot solve problems related to non-math subjects or advanced mathematics.
2. If the text is ambiguous or the camera quality is poor, the app may produce inaccurate results.
3. Over-reliance on the Photomath app may limit the user's ability to solve problems manually.

C. ChatGPT

ChatGPT is one of the most intelligent and promising AI technologies in the field of education. It is a natural language processing (NLP) system based language model that employs deep learning (DL) techniques to simulate human-like conversations.

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ChatGPT is capable of generating text that closely resembles human writings on a variety of subjects, including customer services, research papers, mathematical theorems, etc. This is one of the largest currently available language models that was built using the generative pre-trained transformer-3 (GPT-3) framework based on 175 billion parameters. Guo et al. (2023) pointed out the vast potential of ChatGPT to improve education, solve mathematical problems and enhance the learning skills of the students.

Learners and educators can get immediate responses to their queries using cutting-edge innovation. ChatGPT enables interpretation of complex mathematical concepts and formulas in an easy way. Additionally, individuals can get assistance from AI to solve laborious math problems. Apart from this, one can get hints and tips from ChatGPT to overcome the obstacle that occurs during solving the specific mathematical problem. In generating all the solutions to different queries related to mathematics, one of the most remarkable aspects of ChatGPT is that it does not require mathematical expertise to operate (Wardat et al. (2023)).

Despite being a capable tool for solving mathematical problems, even ChatGPT is not without its limitations.

1. Since it is an NLP-based language model, it may sometimes generate irrelevant or incorrect responses.
2. Additionally, it may sometimes fail to understand the context of certain topics and symbols of mathematics.
3. It is simply a tool that cannot substitute the educators and teachers.

III. Benefits Of Artificial Intelligence Integrated In Mathematics Education

In the modern era, where AI is supporting the functioning of different fields, it also plays a tremendous role in the education system. A few of the impacts are explained as below:

A. *Easy learning***:** There are many AI-based softwares that help in personalized learning. It helps to create content based on individual recommendations. Apart from this, it also adds level-based tests on individual learners to test their learning abilities.

B. *Personalized tutors*: Artificial intelligence helps the students as a personalized tutor that can provide instant feedback to learners and assist students with their mistakes and guide them to improve their skills outside the classroom.

C. *Beneficial for students with disabilities:* Both ChatGPT and GeoGebra provide tools that can convert text to speech or speech to text, making learning easier for students with disabilities. AI makes learning more interesting and fun for students with cognitive disabilities.

D. *Games and mathematics***:** Different softwares help the learners to learn mathematics having great fun with help of gamification. The students can learn the subject by playing math related quizzes and games. It helps students to develop more mathematical skills and concepts.

E. *Professional learning:* AI helps to enhance teachers' teaching skills by detailed analysis of their teaching skills through personalized workshops and resources. It also provides approaches for better growth.

F. *Multilingual help:* AI systems help students to learn mathematics in multiple languages.

G. *Visualization of mathematical problems*: AI softwares (such as GeoGebra, Photomath and many more) help students to get a better understanding of geometric shapes and special relations.

H. *Math and research:* AI provides infinite help to researchers to identify different patterns in mathematics education.

IV. Challenges And Ethical Results

While AI offers numerous benefits in mathematics education, it also faces several challenges that must be addressed to maximize its effectiveness and ethical use. Here are some of the key challenges associated with AI in learning mathematics:

A. *Lack of understanding of mathematics concepts:* In using AI-based softwares for mathematics concepts, it was observed that the results produced by them are not accurate. The accuracy and effectiveness of solutions may vary depending on factors like the equation complexity and the instructions provided.

B. *Lack of teacher training:* Many teachers and practitioners lack the necessary knowledge and skills to integrate AI tools into their teaching practices effectively. Therefore, teacher training and professional development are essential to utilize AI in mathematics education.

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C. *Data privacy concerns:* The use of artificial intelligence in education requires the collection of data, which may raise concerns about privacy and data security of personal information. Due to unauthorized access, cyber-attacks on AI systems can lead to the compromise of personal data.

D. *Overreliance on technology*: Overreliance on AI technologies for problem solving can hinder the development of students' critical thinking skills. Students may not fully understand the concepts and principles behind the problem they are solving.

E. *Technology issues*: Sometimes, AI tools may not work properly on students' device or school's technology. This can happen because the internet is too slow, or there are some software problems. When these issues occur, students may face difficulties in using AI tools during their lessons.

F. *Lack of human interaction:* Traditional classroom environment encourages direct interaction between students and teachers, allowing teachers to access students and alter their instructions accordingly whereas AI cannot fully replicate. This can impact the development of social skills and emotional intelligence.

G. *Inequitable access:* Not all students have equal access to AI technologies. This can widen the gap between students who have access to advanced tools and those who do not, leading to inequality in educational opportunities.

H. *Symbolic representation*: Mathematical expressions frequently involve symbolic elements like variables and operators. All softwares need a strong understanding of mathematical symbols and rules to interpret and manipulate expressions accurately.

I. *Resistance to changes:* Resistance to adopting AI driven educational tools and methodologies can be a challenge among both educators and students. Some educators may hesitant to embrace technology in their teaching practices.

J. *Sustainability and cost:* Developing and maintaining AI driven math education systems can be costly. Apart from it, many educational institutions may not have the resources to implement such technologies effectively.

V. Conclusion

Artificial intelligence has played tremendous role in enhancing the interest of learners in important fields of day to day life like mathematics.

It enables physically challenged students to have knowledge about different concepts of Mathematics through text to speech and speech to text provisions. It not only help the students to learn new concepts but also enable them to test themselves on their level. On the other hand as none of invention is without its bad side. AI on our hand where the mathematics learning has made easy on the other hand has made the people software dependent. They are losing the habit of keeping facts in mind. Thus use of AI in Learning and academics is good up to certain level but overdependent is not useful in long run.

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